METABOLISM of Organic Molecules

- Carbohydrates, Lipids & Proteins
  * Utilize SAME:

**Carbohydrate Utilization:** “Quick Energy”

- **Storage Form**:
  * 75% faster:
  * ~1% of total body energy (350g or 2,000 Kcal)
    ∼ Majority stored in:
    * 
    *

- **Synthesis**: Glycogenesis
  * Link:
    * Stimulated by hormone:
      * Regulates:
        Store cellular:
        Increases cellular:
        * Site of production:
        * Stimulus:
          ∼ Following a meal: 140-150mg/dl
          ∼ Normal: 65 – 105 mg/dl

- **Effect**:

  - Primary Effector Tissue:
    * Muscle & Adipose: GLUT4 glucose channels are:
    * Insulin receptors activate: Glucose storage:
    * Effect:
• **Glycogen Utilization**: Glycogenolysis

☆

* Muscle: Make glucose available for :
* LIVER: Releases:

~~ Stimulated by:

a. **Epinephrine**: hormone “Adrenaline”

• Site of production:
• Stimulus :
  ✓
  ✓

b. Glucagon: Regulates body sugar

• Site of production:
• Stimulus :
  ✓

⇒ Overall Effect:

**LIPIDS** :

• **Storage Form** :
  ☆ Macromolecule :
  ☆ ~80-85% :
  ☆ ~55% of all carbohydrate:

• **Synthesis**: Lipogenesis
  ☆ Primary Location:
  ☆ Reaction:
  • Reactants:
    a. **Glycolysis intermediates**
      ✓ Acetyl CoA link forming ~
      ✓ Phosphoglyceraldehyde ~
b. Ingested fats

✓ Form:

★ Stimulus:

**Utilization**: Lipolysis

★ Lipase breaks Ester bonds ➡

1.

2.

➡ Stimulated by:

a. **Epinephrine**:

b. **Glucagon**: Regulates:

➡ Overall Effect:

**Fatty Acid Chains Utilization**: 

★ Fatty Acid breakdown:

★ **Fatty Acids** : “CUT” into:

• 16 Carbon Chain = 108 ATP :

a. 4 ATP : Per every 2 carbons cut

b. 10 ATP: per Acetyl CoA

★ 7 two x 4ATP = 28 ATP

★ 8 pieces x 10 ATP = 80 ATP

➡ 28ATP + 80ATP = 108ATP

**β-Oxidation – Requires**

✓

**PROTEINS**: 

★ Account for:

➡ NOT designed as an energy source

★ **Ingested Proteins**: Used for:

1. Growth & repair:

✓ **Positive Nitrogen Balance**: Ingest more Nitrogen than:

2. Everyday Protein “Turnover”:

✓ **Nitrogen Balance**: Excretion is balanced by:

(Positive Nitrogen Balance: Starvation)

★ Transamination: Inter-conversion of:

➡ **Transferring**:
11 Nonessential Amino Acids:

\( \Rightarrow \) Inter-converted by:

9 Essential Amino Acids:

\( \Rightarrow \) NOT inter-converted by:

Transamination uses:
1. Pyruvate
2. AcetylCoA
3. Krebs Cycle intermediates (keto-acids)

- Oxidative Deamination: Amino Acid -

Protein Turnover: “Used” amino acid skeletons are:

Processed Nitrogen Removed:

Cellular Energy Sources:

- Tissue preferred energy sources:
  a. Brain:
  b. Skeletal Muscle (Rest):
  c. Skeletal Muscle (Exercising):
  d. Liver:

Ketone Bodies:

- Produced by Liver when glucose is:
  *
  *
- Obtained from breaking:
  * Produced from:

Metabolic Result: Ketosis:

- Elevated levels of:
- Ketone bodies are:
  *
  *

Glucose can NOT be made from:

Body needs energy in an alternate fuel:

Study Questions:
1. Following ingestion of a carbohydrate rich meal, blood glucose levels increase rapidly. Which hormone is released in response to the increasing levels of glucose; from where is this hormone released? What polysaccharide is formed in response to this hormone? What is this process of glucose storage called? Where is it most likely to occur in the body?

2. Approximately how much energy is stored as a carbohydrate in our bodies?

3. When blood sugar levels decrease or there is a stimulus of the sympathetic nervous system, which two hormones will be secreted in response? From where is each hormone released? What affect do they have on carbohydrate storage? What is this process of utilization called?

4. Approximately how much energy is stored as triglycerides? What is the process of triglyceride formation called? What stimulates triglyceride formation? What is the triglyceride forming reaction called? Where is the primary location for this process?

5. Triglycerides are formed from which glycolysis intermediates?

6. What is lipid utilization called? More specifically what is the process that utilizes the fatty acid chains of a triglyceride called? Explain why this form of metabolism can only occur aerobically. (in the presence of oxygen)

7. Gram for gram which nutrient contains the greatest concentration of energy?

8. Why must we ingest certain proteins? What is the difference between essential and nonessential proteins? If proteins are NOT designed to be a initial source of energy why are they so easily incorporated into the Krebs Cycle (what is the significance)?

9. What is the function of transamination? How is this different from oxidative deamination?

10. Why do different tissue utilize alternate organic molecules as sources of energy? What is the main source of energy for the brain & for the skeletal muscle (during exercise and at rest)?

11. Describe the utilization of fatty acids and glucose upon the energy demand in skeletal muscle?

12. One of the new categories of drugs being tested in professional athletic screening are those which function to stimulate bulk storage of glycogen in the muscle. Describe how you think this would increase performance in endurance events?

13. Explain why starvation, diabetes, and severe dieting results in the formation of ketone bodies. What are some of the signs rapid lipolysis? Why is ketosis such a problem (potentially leading to coma and death)?

14. Why can’t the body just convert fatty acids into sugars when sugars are scarce?